PEST TECHNOLOGY
Pest Control and Pesticides

Technical Editor - A. K. Palmer, B.Sc.

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CONTENTS

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Communications

RECENTLY, a number of events having a direct or indirect bearing on the pesticide industry, have occured. First and foremost of the events having an indirect influence are the steps being taken to bring agriculture with into line other industries in the matter of education. Two publications —the First Report of the Advisory Sub-Committee (on Further Education for Agriculture) of the National Advisory Council of Education for Industry and Commerce and the N.F.U. Policy for Agricultural Education—come out strongly in favour with the recommendations of the De La Warr Committee, who stated that if the steady increase in efficiency of production is to continue, the industry will have to rely in the future on a more highly skilled though smaller labour force; the prosperity of the agricultural industry as a whole and that of the individual farmer depend upon the intelligent use of up to date knowledge and techniques.

To further this progress we can hope to see, in the future, the introduction and development of better facilities such as apprenticeship schemes, part and full time courses of further education. For those obtaining diplomas and certificates and generally improving their knowledge as a result of attending the courses, the rewards, in the form of better paid and more interesting jobs, will induce into the farming world members having the 'know how' that will enable them to take the fullest advantage of modern methods. Let us not forget that the use of agricultural chemicals is one of the most important of modern techniques, and the pesticide industry will benefit from the increase in knowledge of the agricultural community.

Of the factors having a direct influence on the pesticide industry there is the recent introduction onto the U.K. market of six chemicals, namely three organophosphorous insecticides, one carbamate insecticide, a herbicide—primarily for potato haulm destruction—and a further extension to the range of dithiocarbamate fungicides. In addition, May has witnessed the culmination of a mementous year for A.B.M.A.C. which has steadily enhanced its reputation despite a spate of adverse and uniformed criticism. Some of the Association's achievements are mentioned in our report of the annual dinner, others we have noted in previous issues.

There is one comment we would like to add. In our report, the presence of Lord Hurcomb, President of the Council for Nature was referred to as being the first time that anyone from 'over the fence' has been to an A.B.M.A.C. dinner. The phrase 'over the fence' is a bad one, it implies that the views of the naturalist and the pesticide manufacturer can never be reconciled. This, of course, is a fallacy and whilst there may always be a few extremists it was made abundantly clear by both Lord Hurcomb and Mr. Mellor, Chairman of A.B.M.A.C., that naturalists and those responsible for the control of pests can reach an acceptable compromise.

Perhaps past differences have been due to the fact that the naturalist has found it difficult to obtain authoritative data regarding the effects of pesticides on wild life, consequently on gathering evidence for this purpose he has based his arguments on what **may be** hazards. The pest control worker, on the other hand, uses the results of his experience and intimate knowledge of hazards which **are already** known. Thus the views of the naturalist will be the more alarming and much of this will be due to man's tendency to have a greater fear of the unknown. Wider dissemination of knowledge and the pooling of ideas by joint consultation can go a long way towards solving this problem. For this reason we hope that Mr. Mellor's suggestion, that naturalists should be allowed to present papers at conventions organised by A.B.M.A.C. and kindred organizations, will materialise. The resultant interchange of ideas would be of benefit to all.

INSECTICIDAL ASPECTS OF MALARIA ERADICATION

By D. J. COLWILL, B.Sc. (*Information Officer, Colonial Pesticides Information Service.*)

THE World Health Organisation (W.H.O.) introduced on the seventh of April—a date which commemorates its inauguration in 1948—its theme for the current world health year. The theme: Malaria Eradication—A World Challenge.

Malaria eradication, by definition, means the ending of transmission of malaria and the elimination of the reservoir of infective cases in a campaign limited in time and carried to such a degree of perfection that, when it comes to an end, there is no resumption of transmission.

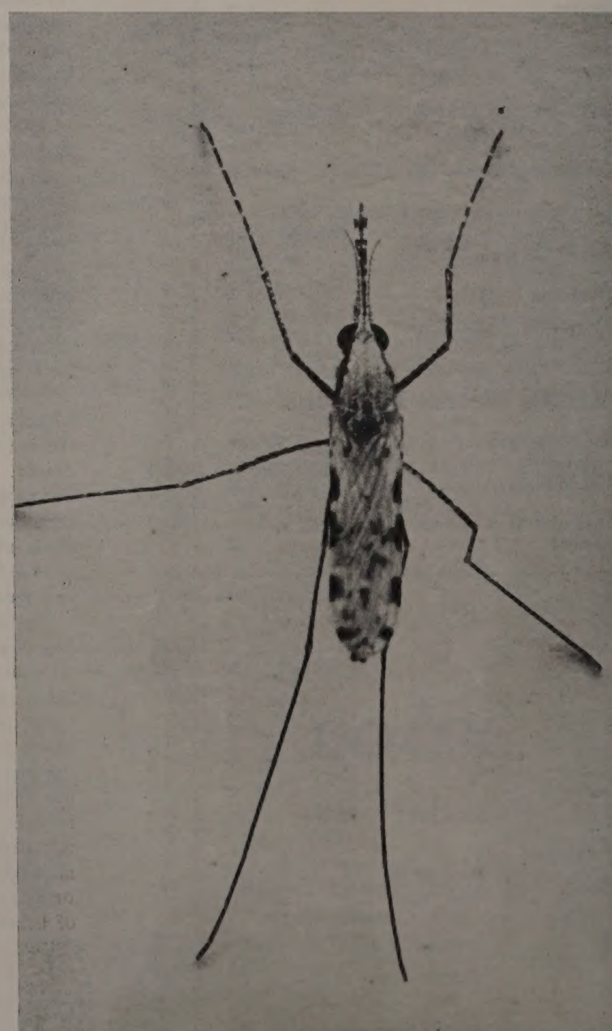
The challenge is a bold one, for the declared aim is the liberation from the disease of 1,200 million human beings in 148 different lands throughout the malarious areas of the world. Such a campaign can only be attempted if sufficient money, sound management and technically trained personnel are available. Support for the campaign has in fact been unanimous and unprecedented.

In the words of the Director General of W.H.O., Dr. M. G. Candau: "Without a dissenting voice the ninety members of the W.H.O. have resolved to pool their knowledge and resources to achieve nothing less than the complete elimination of this disease from our globe."

It is proposed here to take stock of the present situation.

Prior to 1948 the number of persons infected annually by malaria amounted to 300 millions of which at least three million died. In ten years of campaigning these figures were cut by some 30%. The disease has virtually been eliminated in thirteen countries: Barbados, Cyprus, Singapore, Tobago, Italy, The Netherlands, Corsica, Martinique, Chile, Puerto Rico, Byelorussia, Ukraine and the U.S.A. Anti-malarial operations are proceeding in one form or another in a further 79 territories. There remain 56 other countries with a population of 200 millions where a beginning has yet to be made.

Looking at the situation another way it is anticipated that malaria will have been banished from the continent of Europe by 1962. Attack in this quarter is being



concentrated around the Mediterranean strongholds—Turkey, Morocco and Algeria. Victory is in sight in Spain, Portugal, Rumania, the Soviet Union and Greece. Greece, incidentally, once the most malarious region in Europe—pioneered the W.H.O. antimalarial campain, and was the scene of the first internationally supported large scale operations with DDT. In the Americas it is expected that the threat to 135 millions will shortly have been removed, already 80% of this number having been protected. Now the challenge is principally in Africa and Asia, particularly China and India, where only a relatively small beginning has been made and vast populations are still vulnerable.

The effects on a human population released from a scourge of such magnitude cannot entirely be estimated in hard cash although increases in morale, and psychological well being, with concomitant drive and initiative, are among the long term benefits which lead to economic improvement and increased prosperity. It has been shown for example, that the loss of earnings in Afganistan amounted to about seven million pounds annually; the cost of ten years anti-malarial operations was about £270,000. The saving in Ceylon has been over ten million pounds annually; six times the total expenditure on the ten year campaign. Whilst in Mexico it is expected that for an eradication programme costing about seven million pounds the saving will be more than sixty millions annually.

The conquest of malaria on this present scale would not have been possible with the methods available in the nineteen-thirties which were in principle based on the treatment of mosquito breeding places with larvicidal agents, e.g. spreading oils and Paris green.

It was realised however that the best chance of success lay in killing the adult female mosquitoes (potential carrier of the disease parasite) in order to break the transmission cycle; and from a study of mosquito behaviour it was evident that the most convenient time to hit these mosquitoes would be during their resting period, after a blood meal, on preferred sites such as the interior walls of dwellings.

The first chemical to possess the required properties of a 'residual' insecticide, i.e. highly effective at low concentrations, persistent for long periods and relatively harmless to mammals, was 2,2 bis (p-chlorophenyl)-1,1,1-trichloroethane (DDT). Its insecticidal properties were discovered by a Swiss scientist, Paul Muller, working in the Geigy laboratories at Basle. It was immediately developed by that Company and the first formulations were used with spectacular success to combat a typhus outbreak in Naples in 1943. When the potentialities of DDT had been firmly appreciated, the W.H.O. backed by technical experts from many nations, launched its malaria control programme.

First problems to be tackled related to the performance of insecticides in the field. An Expert Committee on Insecticides, appointed by the W.H.O. began its work in 1949 on specifications which were designed to secure utmost efficiency in large scale application in a diversity of environments.

Earlier specifications, according to Dr. R. A. E. Galley—Officer in charge of Colonial Research and a long-standing member of the Expert Committee—were tightened up as manufacturing techniques improved. At an early stage, however, the ability of formulated insecticides—emulsifiable concentrates and water dispersible powders—to remain stable under conditions of tropical storage, was regarded as an essential requirement of formulations for use in malaria and other vector control programmes. Another desirable property—reaffirmed lately by the Division of Malaria Eradication (W.H.O.) is the readiness with which a powder wets out on addition to water. Parallel to specifications for the chemicals, others were drawn up to ensure that suitable dusting and spraying apparatus was available, ranging from simple "Flitguns" to compression knapsack sprayers.

For some years things went well and DDT was being used with marked success. Then gradually it became evident that the insecticide was losing its effectiveness. Scientific investigations at once began and entomologists were soon to confirm conclusively that mosquitoes in heavily sprayed areas were developing a resistance to DDT.

Resistance can now be regarded as the outward manifestation of an artificially speeded-up natural selection process on a susceptible strain. The insecticide provides the selection pressure. The resistant insects owe their survival to a specific genetic constitution which either existed before the discovery of the insecticide or may, in some cases, since have arisen as a mutation and which, in practice, enables the insect to escape the effect of the poison, by detoxification or other mechanism. Fortunately, as the number of cases of DDT resistance grew, other powerful insecticides with effect against mosquitoes were available. The gamma isomer of benzene hexachloride and the cyclopentadiene derivative, dieldrin, provided fresh ammunition. Their formulation and introduction to field scale use were rapid.

From this time onwards performance of insecticides in the field was closely observed and it has become apparent that resistance tends to build up against specific groups of insecticides. One such group includes DDT and its analogues and another contains gamma BHC and the cyclopentadiene derivatives such as dieldrin. *Aedes aegypti* in Trinidad and *Anopheles sundaicus* in Eastern Java developed resistance to DDT but remained susceptible to dieldrin and gamma BHC. A strain of *Anopheles gambiae* in Western Sokoto, Nigeria, built up a considerable resistance to dieldrin (x 800) which was cross-linked with an increased resistance to gamma BHC (x 30), but the vector remained susceptible to DDT.

Today it is evident that certain strains can gradually develop resistance in varying degree to all the standard chlorinated hydrocarbon insecticides. Research has therefore been directed towards the screening of other groups of compounds such as the organo-phosphorus derivatives many of which exhibit marked insecticidal activity. Among the present compounds which show promise are "Baytex", (0,0-dimethyl-0-4(methyl mercapto)-3-methyl phenyl thiophosphate), chlorthion, (0,0-dimethyl-0-3-chloro-4-nitro phenyl thiophosphate), dimethoate ("Rogor") (containing 0,0-dimethyl-S-(N-methyl carbamoyl methyl) thiophosphate) and malathion (0,0-dimethyl dithiophosphate of diethylmercaptosuccinate).

It is also proposed, in new areas where resistance has not been encountered, to obviate its build up by using knock-out doses of sufficiently high concentration. The use of mixtures of insecticides and of one or more insecticides applied alternately are other probable lines of investigation.

A further problem appeared about the time that insecticide resistance was reported. It was the realisation that the active life of an insecticide was alarmingly brief when deposited on certain porous surfaces. This phenomenon which came to be known as the sorptive effect is particularly significant to the success of spraying campaign in Africa where many of the dwelling places are built with mud-lined walls from local soils which are themselves highly sorptive. The phenomenon of sorption is a complex one for among the theoretical factors which govern the rate of disappearance of the insecticide are: the volatility of the insecticide, the size of the insecticide crystals, the type of mud and how finely it is divided, and the relative humidity of the atmosphere.

Various measures are being adopted to extend the active life of an insecticide on a sorptive material. Wettable powders are used rather than emulsions. The activity of DDT and dieldrin can be enhanced by increasing the dosage rate. BHC can be rendered more persistent by the addition of cereclor, a chlorinated wax. It is early to say how useful the candidate OP compounds will be. At present the disappearance of most of them on a sorptive material is rapid. Decomposition also is a possible factor.

Throughout, a watching brief is being maintained on the health of the spray teams and that of the protected populations against insecticidal poisoning. For protection during application of the more toxic chemicals in hot climates a suitable form of light, plastic clothing, based on P.V.C. is worn. Careful supervision obviates the danger to lives which is greater in many tropical areas where temperatures are higher, nutritional standards are low and where a lack of washing facilities accompanies a general lack of understanding of the risks run.

In addition to the problems already mentioned there remains open another escape route. It is the tendency for certain species to choose resting sites away from the houses treated with insecticides, and thus avoid being killed. The term "behaviour resistance" has frequently been used to describe this change of habit. It was the appearance of behaviour resistance in *Anopheles gambiae* that was largely instrumental in limiting the success of the pilot spraying trial at Taveta-Pare in Tanganyika during the period 1954-59. Though the dosage and spacing of the insecticidal sprays were considered satisfactory, the daily mortality of *A. gambiae* was increased by 10% only to 21-25%. This was insufficient for the interuption of transmission which would require a higher mortality figure.

It is considered by some that a repellent effect inherent in the sprays has caused these mosquitoes to seek refuge out of doors and a search is being made for possible attractants or masking agents.

Finally in some areas like that at Taveta-Pare there is the difficult problem of animal reservoirs of the parasite.

Speculation is ripe as to the course likely to be taken in the future conduct of this world wide campaign. It must be remembered that operations at the beginning had been based on two premises: First, the insecticidal potency of the persistent, contact insecticide DDT. Second, the technique of spraying the interiors of dwelling places with the insecticide in order to kill the female mosquitoes, harbourers of the parasite, during their resting period on the treated wall surfaces. The development of resistance presented a serious threat to the proposed objective—originally the gradual reduction of malaria by vector control. The policy became one of definite suppression of malaria transmission through eradication.

It is probable that in several theatres of the campaign operations will continue on existing lines with a sharpening of the offensive by the use of new insecticides, formulations or spraying equipment, and more stringent surveillance following eradication. It is likely also that there will be an intensified effort in those areas where success is within reach. It is in the vast, sparsely populated lands that the most widespread changes in policy are expected. Whatever future modifications there may be, the efforts of research workers, spray teams and administrations throughout the world bear witness to the words of Dr. Emilio Pampana — first W.H.O. Director of Malaria Eradication:

"We may be confident that when the time comes the countries of the world will make it a point of honour to join forces to overthrow the last strongholds of malaria in Africa. Indeed it will be to everybody's interest to do so, for the continued presence in the heart of our planet of such a reservoir of infection would be intolerable at that time."

SEVIN— A new carbamate insecticide

By G. L. HEY, M.A. *The Murphy Chemical Company Limited, Wheathampstead, Herts.*

Sevin represents a new class of chemical compound quite distinct from both the chlorinated hydrocarbons (e.g. D.D.T., B.H.C.) and the phosphorus insecticides (e.g. parathion, malathion). Technical Sevin contains not less than 95% of 1-naphthyl N-methylcarbamate. It is a crystalline solid with a very low solubility in water and is usually formulated as a 50% wettable powder or as a dust. It has the decided advantage of a very low mammalian toxicity (540 mg./kg.) so that protective clothing is not required either when mixing up the spray material or when applying the diluted wash. Experience abroad to date also indicates that Sevin is less injurious to wild life in general than is D.D.T.; it is also much less injurious to fish.

Fig. 1. Entry hole of Codling moth caterpillar into apple fruit

Another advantage of Sevin is its very low residue toxicity rating so that it can be applied on apples and pears up to seven days before picking. This is of particular importance in Great Britain as it enables it to be applied in August or September to deal with late attacks of Codling and Tortrix Caterpillars. There are also no restrictions in this country on the amount of Sevin that can be applied per acre or the total amount used during the season on apples and pears.

Under the present regulations Sevin has been cleared in Great Britain for use on apples and pears and on non-edible crops but it has not yet been cleared for use on other food crops. Sevin is not included in the Agriculture (Poisonous Substances) Regulations.

There is some evidence that the insecticidal activity of Sevin is increased at higher temperatures both in the laboratory and under field conditions.

Like many other spray materials Sevin is injurious to bees but less so than many other materials in common use. Nevertheless spraying should be avoided when fruit trees or interplanted crops are in flower, and flowering weeds in orchards should be kept down.

SEVIN is a trade mark of the Union Carbide Corporation

Fig. 2. Apple cut open to show codling moth caterpillar and typical damage

The main agricultural interest in Sevin abroad is for use against certain pests which have built up resistance to the chlorinated hydrocarbon insecticides such as DDT, BHC, chlordane, etc. This is particularly so in some cotton growing areas of the world where Sevin has given an excellent control of the principal cotton insects.

It is also finding increasing use on vegetables, and another major use for Sevin is to control resistant Codling Moth on apples and pears. Against this latter pest Sevin also has an added advantage over DDT in that it will kill Codling caterpillars which have just penetrated the skin of the fruit.

Other crops on which Sevin is being used with every satisfaction are tobacco for Hornworm, sweet corn for Corn Earworm, and on peaches, grapes, shade trees, ornamental shrubs and flowers against a wide range of insects.

The normal rate of use for Sevin applied as a wet spray is from 1 to 2lb. of the 50% wettable powder per 100 gallons water. Sevin is compatible with most spray materials in common use but should not be mixed with Lime, Bordeaux mixture, Lime Sulphur or other alkaline materials. Sevin is also used as dusting powders containing from 1.5 to 10% of the toxic ingredient.

One interesting feature of Sevin for agricultural use is the wide range of insects against which it is effective including many species of beetles, Weevils, Caterpillars, Aphids, Suckers, Scale Insects, Leaf Hoppers, Capsids, Thrips, etc. It is not effective against Red Spider or other Mites but unlike DDT does not seem to stimulate oviposition on the part of the Fruit Tree Red Spider.

The immediate interest in Sevin in Great Britain is for the control of Codling Moth to prevent damage to the fruit (Figs. 1,2,3,) and two firms — The Murphy Chemical Company Limited, and Boots Pure Drug Company Limited are marketing 50% wettable powder formulations for this purpose. There is, however, no proof that genuine DDT resistant strains of Codling occur as yet in this country.

Very much associated with Codling Moth is the question of control of Surface Eating Tortrix which damages buds and blossoms in the spring and the surface of the fruit in summer and autumn (Fig. 4.)

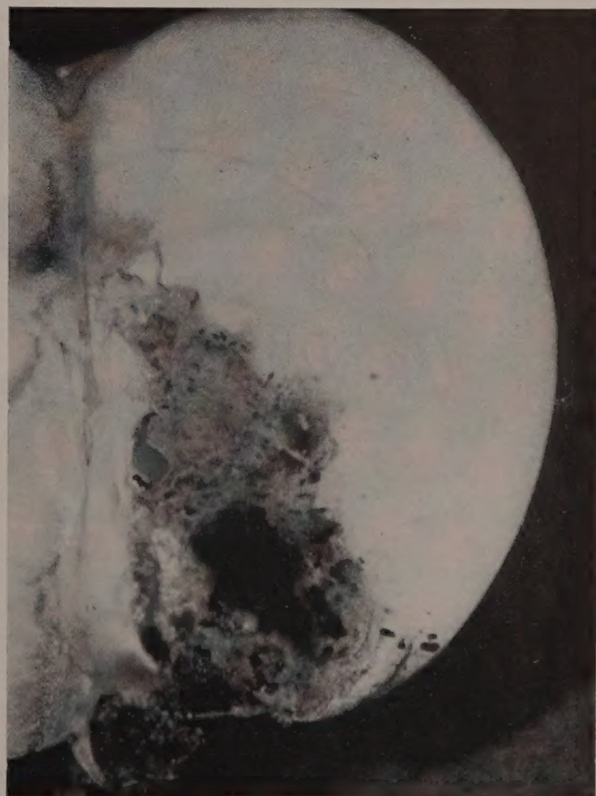
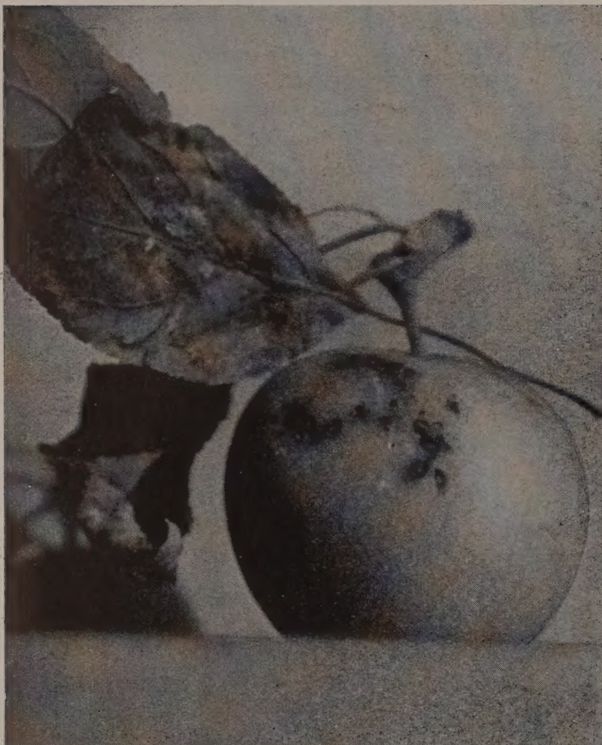


Fig. 3. Apple cut open to show typical codling damage to fruit



The main species concerned is *Archips podana* (*Cocoecia oporana*). Trials with Sevin in this country indicate that it appears to be at least as good as DDT against these Tortrix pests but further investigations are in progress.

There is also the possibility that used at higher rates Sevin may control Aphids, Caterpillars and Apple Sucker for preblossom application in place of combined BHC/DDT sprays.

Apart from its agricultural uses Sevin is being tested with promising results against Locusts, Mosquitoes, Stored Product Pests, Cockroaches, etc., and Ticks, Lice, Fleas, Red Mites, Biting Flies and other ecto-parasites on animals and birds. Sevin is also being tested as an additive to poultry feeds to control Northern Fowl Mite and certain other pests. Trials against ordinary House Flies have shown Sevin to be relatively ineffective.

Fig. 4 Leaf removed to show typical Tortrix damage to fruit surface

ENTOMOLOGICAL SURVEYS OF NATURE RESERVES AND SITES OF SPECIAL SCIENTIFIC INTEREST

Entomological surveys are urgently needed of many of the Nature Conservancy's Reserves and a few Sites of Special Scientific Interest. The Entomological Liaison Committee has suggested that, as an essential first step, the compilation of lists of the species present in each reserve should be started. These lists should also include such notes as are available of the food plant, hosts, etc., frequency and habitat of each species.

Assistance from entomologists in compiling these lists would be very greatly appreciated. Those who are able to offer their help are asked to get in touch first of all with the appropriate Regional Officer whose addresses are given and who will arrange, where necessary, permits, or permission from owners, and give more exact details of the location of the sites and the work needed on them. In certain circumstances grants-in-aid may be available.

Details of the areas where work is most urgently needed are given below.

REGION	REGIONAL OFFICER	*Address*	*County*	*National Nature Reserves (and Sites of Special Scientific Interest where stated)*
NORTH	R. J. Elliott, M.C., B.Sc., Ph.D.	Merlewood Research Station, Grange-over-Sands, Lancs. *Tel.* Grange-over-Sands 2264-5	Lancashire Yorkshire	Roudsea Wood; North Fen; Blelham Bog. Ling Gill.
MIDLAND	T. O. Pritchard, B.Sc., Ph.D.	The Nature Conservancy, Attingham Park, Shrewsbury. *Tel.* Upton Magna 284	Cheshire Staffordshire Shropshire	Wybunbury Moss. Chartley Moss. S.S.S.I. Clarepool Moss, Sweat Mere } S.S.S.I. Wem Moss (not yet notified)
EAST ANGLIA	E. A. G. Duffey, B.Sc., Ph.D.	The Nature Conservancy, Government Offices, Bishopgate, Norwich. NOR 22P *Tel.* Norwich 20558	Norfolk Suffolk Soke of Peterborough Huntingdonshire	Bure Marshes; Hickling Broad; Scolt Head; Weeting Heath; Winterton Dunes. Redgrave and Lopham Fen S.S.S.I. (part). Cavenham Heath; Orfordness-Havergate; Thetford Heath; Westleton Heath; Redgrave and Lopham Fen S.S.S.I. (part) Castor Hanglands. Holme Fen; Monks' Wood; Woodwalton Fen.
SOUTH WEST	J. H. Hemsley, B.Sc.	Furzebrook Research Station, Wareham, Dorset. *Tel.* Corfe Castle 361	Dorset Devon	Hartland Moor; Morden Bog. Axmouth-Lyme Regis Undercliffs.
SOUTH	Miss J. M. Laptain, B.Sc.	Furzebrook Research Station, Wareham, Dorset. *Tel.* Corfe-Castle 361	Oxfordshire West Sussex Wiltshire	Wychwood; Aston Rowant; Beacon Hill (Forest Nature Reserve). Kingley Vale. Fyfield Down.
SOUTH EAST	P.A. Gay, B.Sc., Ph.D.	19 Belgrave Square, London, S.W.1. *Tel.* Belgravia 3241	East Sussex Essex Kent	Lullington Heath. Hales Wood. High Halstow.
NORTH WALES	B. Seddon, B.Sc., Ph.D.	Y Fron, The Crescent, Upper Bangor, Bangor, Caerns. *Tel.* Bangor 3512	Anglesey Caernarvonshire Merionethshire	Newborough Warren - Ynys Llanddwyn. Coed Dolgarrog; Coed Gorswen; Coed Tremadoc; Cwm Idwal. Cader Idris; Coed Camlyn; Morfa Harlech; Rhinog. Coed Cymerau S.S.S.I.
SOUTH WALES	P. Walters Davies, B.Sc.	Dept. of Zoology, University College of Swansea, Singleton Park, Swansea. *Tel.* Swansea 56172	Brecon Cardiganshire Glamorgan Pembrokeshire Monmouthshire	Craig Cerrig Gleisiad; Craig-y-Cilau. Coed Rheidol; Cors Tregaron. Gower Coast. Skomer Island. Blackcliff and Wyndcliff (Forest Nature Reserve).
NORTH EAST SCOTLAND	J. Grant Roger, B.Sc.	12 Hope Terrace, Edinburgh, 9. *Tel.* Morningside 4784-6	Aberdeenshire Inverness-shire	Sands of Forvie. Cairngorms; Craigellachie.
WEST SCOTLAND	J. Morton Boyd, B.Sc., Ph.D.	12 Hope Terrace, Edinburgh, 9. *Tel.* Morningside 4784-6	Ross-shire West Inverness-shire.	Beinn Eighe; Rassal Ashwood. St. Kilda.
SOUTH SCOTLAND	T. Huxley, M.A.	12 Hope Terrace, Edinburgh, 9. *Tel.* Morningside 4784-6	Buteshire Dumfriesshire Kircudbrightshire Stirlingshire	Glen Diomhan, Arran. Tynron Juniper Wood; Caerlaverock. Silver Flowe; Kirkconnell Flow. Clairinsh.

Continued from the May issue

RELATIONSHIPS BETWEEN CHEMICAL & BIOLOGICAL CONTROL OF FOREST INSECTS

By R. E BALCH, Forest Biology Laboratory
Fredericton, N.B., Canada

PART II

Larvae of pine sawfly killed by a virus disease used for the control of this insect in Canada. Photo. D.C. Anderson, Forest Insect Lab. Sault St. Marie.

Biological Control, Silvicultural Methods and Conclusions

The term " biological control " is generally reserved for the direct use of enemies or pathogenic organisms. The idea originated as a means of restoring natural control of foreign pests and was based on the assumption that insects transferred from their native environment often become pests because their enemies are left behind. This is not the only reason why introduced species become pests but there is considerable evidence that it is an important one. The chief natural enemies of insects are insects. Many attempts have been made to control foreign pests by introducing parasitic or predacious species. Some spectacular successes have been obtained. At the same time other attempts have been considered failures, or have not resulted in sufficient improvement in control to make chemical or other methods unnecessary.[12]

Complete success means that the pest is brought under permanent economic control so that no other methods are necessary. Taylor[13] has suggested that this is unlikely except in more or less tropical climates and in " ecological islands ", and that partial successes are not much value. This has little foundation in forest entomology.[14] It is true that a good proportion of the successes have been on tropical islands, but they have also been obtained on continental areas in temperate climates. An example will follow. Also, partial successes, by which outbreaks are reduced in severity or extent although some damage still results, may be of considerable value. They will reduce the need for other methods and, as already mentioned, in forestry moderate improvements in control will often suffice.

For these reasons, and because many of our worst forest pests are of European origin, a good deal of work has been done in Canada on biological control. It has been the policy, as soon as a pest is known to be an introduced species, to investigate the possibilities of obtaining parasites, predators, or pathogenic organisms from abroad. This is arranged through co-operation between the Division of Forest Biology, the Entomology Research Institute for Biological Control, and the Commonwealth Institute of Biological Control. At the same time a study is made of the ecology of the pest in Canada. The most promising primary enemies that are discovered abroad are then introduced to the

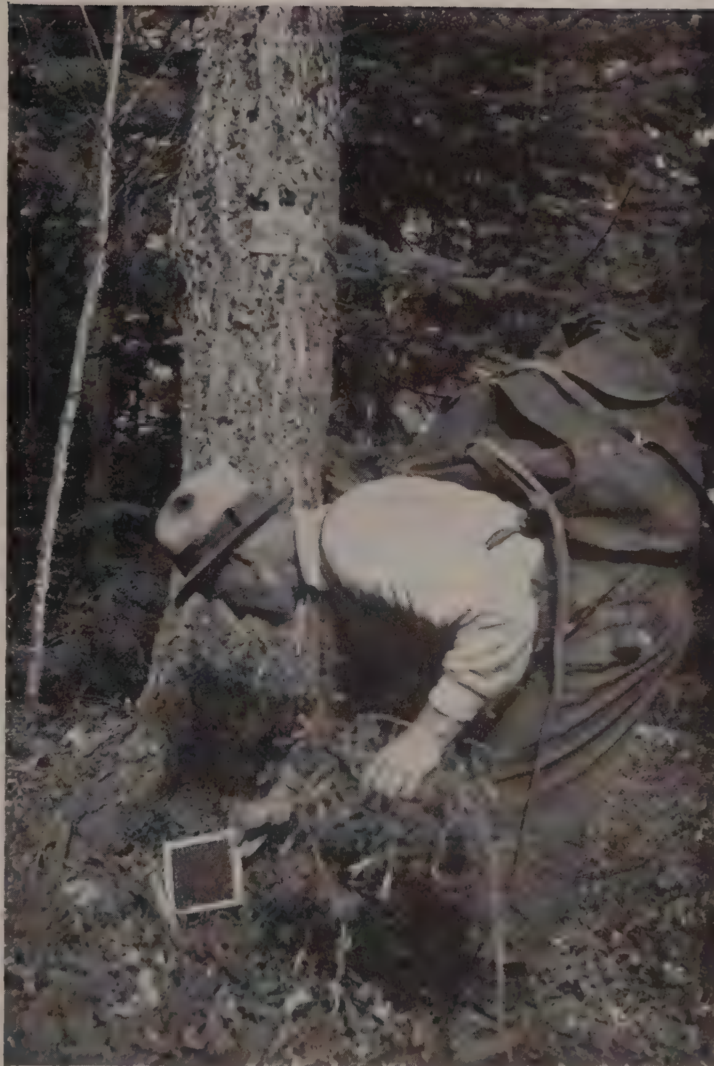
study areas where their establishment, spread, and effects on the control complex are investigated. One of the objectives is to develop quantitative techniques of study.

The possibilities can be illustrated by the example of the European spruce sawfly. This insect defoliates our most valuable tree species. When first discovered in 1930, it had already infested several thousand square miles severely and during the next decade large quantities of timber were killed. Native parasites did not attack it and introductions of European parasites were commenced in 1933. By 1938 several species had been established and two of these showed their control value at high densities. About the same time a virus disease began to cause high percentages of mortality, often exceeding 99%, and in a few years the outbreak was brought to an end.[3]

To discover whether these new factors would be effective at low levels, careful studies of the natural control of the sawfly have been maintained and now cover 20 years since its numbers were reduced to endemic proportions. This work shows that the two species of parasites which attacked the sawfly effectively when it was numerous are now scarce. At the lower levels it is being attacked by two other introduced species and the relation between parasitism and population trend indicates they are key factors in control. The virus is responsible for a smaller percentage mortality, which also is related to population trend. It seems clear that permanent economic control has been achieved with the addition of the parasites and the virus to the complex that determines sawfly numbers. The results support the conclusion that the chances of permanent control increase with the number of factors involved.

Methods of propagating and storing the virus have been developed. It can be introduced to areas where it is absent, and has been successfully established in Ontario and Newfoundland. This work led to the introduction of another virus against the European pine sawfly, *Neodiprion sertifer* (Geoff.), and its use commercially with the aid of aeroplanes.[15]

Each pest, however, presents a different set of ecological problems and those that can be fully controlled by biological means may be the exception rather than the rule. Control may be necessary at levels below those at which natural systems can maintain them. What succeeds in one case may fail in another. This may be illustrated by comparing the spruce sawfly with the balsam wooly aphid, *Adelges piceae* (Ratz.), another introduction from Europe to North America.[3] This small insect is very destructive to several North American species of fir (*Abies*) because they are sensitive to its salivary injections. Comparatively light infestations cause serious damage. No parasites or diseases are known and its only natural enemies are insect predators.



Ranger distributing parasites introduced against European spruce sawfly. Square contains cocoons, packed in moss between wire screening, from which parasites will emerge. *Photo. Canada Dept. of Agriculture*

As chemical control is impracticable under our forest conditions, a serious effort is being made to improve natural control by introducing a number of predators from other continents. Two of the species established have shown their ability to reduce the severity of infestations and the rate of damage and spread. As yet, however, a predator has not been found that will attack infestations at an early enough stage to prevent damage. The search is continuing. It is based on the assumption that the larger the complex of natural enemies the greater is the probability of control.

The general principle that natural systems increase in effectiveness with the number of potential controlling factors underlies most attempts at biological control. Although the number of intensive studies necessary to establish such a generalization has not been made, it

is supported by such cases as the spruce sawfly. We know that different factors become effective at different population densities and under different environmental conditions. If enemies and diseases are actually key factors, a considerable number of different species may be necessary to meet changing conditions in a variable environment such as the forest. Natural systems have evolved in the direction of increasing complexity: the greater the number of interdependent species of plants and animals in an association the more stable their populations become. They may, however, be disturbed by changes in the physical or biological components of the environment. When a species is introduced to a new and favourable environment the enemies present are likely to be imperfectly adapted to control it, compared to those that have evolved in its native habitant. The resulting imbalance may be corrected by introducing as many as possible of its original 'enemies' that have become adapted to it in its original habitat. It is difficult to foresee which of these will be effective in the new environment and the best way to find out is to try them. With insect predators, parasites and diseases, which are specific to a limited number of phytophagous hosts, the danger of adverse effects seems negligible and competition between them is unlikely to reduce their total value. This, at least, is the inevitable empirical approach in the present stage of our knowledge.[3]

Few attempts have been made to use these biological methods against native pests and they do not provide much encouragement. It is possible that enemies have evolved in association with related hosts in other regions that would be more effective than those already present where the pest is indigenous, but the probability is not great. Several parasites and a virus of *Cacoecia murinana* (Hbn.) have been introduced from Europe to Canada and tested against its close relative the spruce budworm but without success.

As our knowledge of insect pathology advances, however, there is little doubt that new methods of using diseases will be found. New viruses affecting insects are being discovered at a rapid rate. Some are highly pathogenic to a single species, as the virus of the spruce sawfly, and may play an important part in control, with or without artificial dissemination. Others are only mildly pathogenic under normal conditions but cause mortality in populations affected by unfavourable weather or food. Some appear to be latent unless combined with another virus or "triggered" by some unknown factor. Populations may vary in their resistance to virus infection. It is, therefore, possible that a native pest might be controlled by the introduction of a virus from a foreign population on which it had little effect.

Research in insect pathology has been greatly stimulated in recent years and is uncovering some promising possibilities of more refined methods of control.[16] Microorganisms can be used not only to improve natural control but also as a form of insecticide. *Bacillus thuringiensis* (Berliner) is being cultured on a commercial scale for this purpose. It produces a substance highly toxic to a number of insects.[16] This is being tested as a substitute for chemical poisons. Such bacterial toxins may be more selective in their action and avoid some of the undesirable effects of insecticides now in use.

Silvicultural Methods

The need for direct chemical or biological methods arises when the forest either lacks efficient control factors or fails to provide a suitable environment within which they can operate at an economic level. In forestry it is necessary to use silvicultural methods that will create and maintain an environment favourable to the growth of the desired tree species. As far as possible it should also favour the operation of natural systems that control the numbers of destructive insects. The "density-dependent" factors in these systems, such as competition and certain natural enemies, tend to produce fluctuations about a mean density but it is the climatic and vegetational conditions in the environment that determine which factors control the limits of these fluctuations and the mean density about which they take place.

The conditions that favour natural control will vary with the species of insect. As forests contain many potential pests the objective must be to produce conditions that favour the control of tree-feeding insects in general and at the same time increase the resistance of the trees to damage. Some general principles are fairly well established.

Pure stands of single tree species are more susceptible to outbreaks than mixed stands. One reason for this has been indicated. Mixed stands contain a richer flora and fauna and this increases the chances of control by inter-specific competition and natural enemies. Another reason is that many insects will attack only one tree species in a stand. When this species is scattered the insect suffers greater mortality from dispersal and its potential rate of increase is reduced. Dispersal from the host tree is a common phenomenon in immature larval stages and often an important cause of mortality that sometimes increases with population density.

Vigorous stands are less susceptible to attack by many insects than weakened or slow-growing stands. They are also less vulnerable to injury or have a greater capacity to recover from attack. Many bark beetles and borers, for instance, will not attack vigorous trees, or if they do their offspring fail to mature. Some defoliators and sucking insects appear to multiply more rapidly on older or less vigorous trees. There are exceptions, such as the white pine weevil, that prefer fast-growing trees but there is no doubt that trees lacking vigour are particularly vulnerable to attack. Silvicultural practices designed to maintain optimum growth, such as prompt harvesting at

maturity, thinning, and use of tree species suitable for the site, are also an insurance against insect damage. Short rotations and short cutting cycles decrease the hazard.

Another principle is that the hazard of insect attack increases with the size of the areas of uniform age and composition. This is largely because of the effects of dispersal already mentioned. A scattered distribution of susceptible stands has the same advantage as a scattered distribution of individual host trees. The spruce budworm outbreaks in Canada, probably the largest and most devastating that occur anywhere, arise in large areas of forest in which there is a high percentage of mature or near mature balsam fir, its most favourable host. Similarly, huge outbreaks of the forest tent caterpillar, *Malacosoma disstria* Hbn., get their start in extensive stands of even-aged poplar that have followed fires.

None of these principles conflicts with the principles for obtaining maximum growth, although they may involve problems in management. They are a guide to specific silvicultural practices that will reduce the need for direct methods of control. The latter, however, will still be necessary owing to the limitations of natural controls and their disturbance by extremes of weather and the operations involved in establishing and harvesting forest stands.

Conclusions

There is no overall cure for forest insect problems and there is little point in saying that silvicultural, biological, or chemical methods are best. This will depend on the insect and existing ecological and economic conditions. But, whatever method is used, it should be recognised that it is being applied to dynamic populations with large inherent capacities for multiplication which are limited in a great variety of ways by fluctuating complexes of interacting factors. From a long-term viewpoint the first objective should be to create silvicultural conditions favourable to natural control. When this is impossible, or fails, the possibilities of biological control should be seriously investigated, particularly in the case of foreign pests. When neither silvicultural nor biological methods are effective, or pending their discovery and application, insecticides may be the only solution. The formulation, dosage, and timing should be chosen with all possible regard for effects on other species, as well as the dynamics of the pest population.

In the present state of our knowledge this may sound more pious than scientific. Although an understanding of the dynamics of populations is fundamental to the proper solution of most problems in economic entomology, few if any studies have yet been completed that are sufficiently exhaustive to test the theories based on observations and laboratory experiments. Techniques for the measurement of natural populations and mortality factors are being developed, but they will need to be applied to a long series of generations and a number of different environmental conditions before a truly scientific basis for the choice of control methods can be established. Meanwhile, this will remain largely a matter of judgement based on incomplete information. A good deal of research is now being directed toward the improvement of methods of collecting and analysing population data so that the long-term results of different control projects can be more critically assessed.[17] Future progress seems to lie in this direction.

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NEWS

Phosphamidon Introduced to Britain

May & Baker Ltd., recently announced that they are introducing 'Dimecron', a formulation of phosphamidon, to the U.K. market.

The preparation and properties of phosphamidon were first announced by F. Bachmann during the fourth International Congress on Crop Protection in November, 1957. Since then it has been in use in the U.S.A. and other overseas countries and in this country May & Baker have carried out intensive field trials.

Phosphamidon (chemical name dimethyl 2-chloro-2-diethyl carbomyl-1-methyl vinyl phosphate) is a systemic insecticide which is rapidly and completely absorbed by the foliage. In one experiment, on apple trees, over 50% of the compound applied was absorbed within an hour. May & Baker claim that it is fully translocated both downwards to the root and upwards to the foliage although in certain American literature only upward translocation is claimed (i.e. from lower foliage to the upper foliage and fruit). In addition it is also absorbed, though not so quickly, through roots and bark.

It acts as a specific stomach poison, inhibiting cholinesterase activity, and controlling such insects as aphids, leaf hoppers, mites, thrips, sawflies, codling and other fruit moths, bollworm, dipterous leaf miners, cherry fruit fly, stem borers and other phytophagous insects. Due to its rapid action it is a particularly useful weapon for use against *Myzus persicae*—the principal vector of virus yellows of sugar beet—which is difficult to control because of its habit of migrating from plant to plant rather than forming static colonies. Being an efficiently translocated systemic it is also effective against the Mangold fly (*Pegomyia betae*), which is protected from contact insecticides by virtue of the leaf blisters formed around the maggots.

Of extreme interest to the top-fruit grower is phosphamidon's 2 to 3 weeks persistence which will allow him to simplify his spraying programme to two or three applications. The first application at total petal fall will control apple sawfly, red spider, and aphids, including leaf rollers and woolly aphid. Timing of the second application will be dependent upon the codling moth and red spider situation but will normally be made in mid-June. For the control of codling moth correct timing is essential where the older contact insecticides are being used but it is not so critical with phosphamidon due to its persistence. A third application will only be necessary where there is a prolonged attack of codling moth.

Although no data are available from May & Baker, phosphamidon is reputed to be of similar toxicity to parathion. It is poisonous if swallowed, inhaled or absorbed through the skin and it is classified in the Second Schedule, Part III of Agriculture (Poisonous Substances) Regulations. This means that gloves and face shields must be worn whilst handling the concentrate but protective clothing is not required for spraying.

As phosphamidon is a stomach poison with little or no contact activity and as it is rapidly absorbed into the leaf tissue there is very little risk of poisoning insect predators such as the ladybird larvae. Moreover the predator's habit of taking its prey alive reduces the risk of them receiving a toxic dose by the injestion of poisoned aphids. Phosphamidon is toxic to bees but field experiments have shown that when sprays are applied early or late in the day bees have worked sprayed crops without increased mortality. Application of this compound must not be made within three weeks of harvesting.

With the exception of lime sulphur and Bordeaux mixture the 'Dimecron' formulation is compatible with a wide range of pesticides and plant nutrients.

Plant Protection to Handle Dowpon

A considerably enhanced technical advisory service on the use of Dowpon, the safe, systemic, couch, reed and grass weedkiller, is foreshadowed as a result of new appointments announced by Dow Agrochemicals Ltd., manufacturers of Dowpon, and an agreement reached between them and Plant Protection Ltd., the well-known pioneers of crop protection.

Dow Agrochemicals have considerably increased their staff of technical representatives, and their services, together with those of the technical advisory staff of Plant Protection Ltd., will be available to farmers. At the same time Dow announce the appointment of Mr. Harry Lawson as crop Protection Advisor. Mr. Lawson holds agricultural science degrees from Glasgow and Reading Universities, and has the unique distinction of two years practical experience of "chemical ploughing" with the aid of Dowpon in New Zealand.

Under the same agreement, Dow Agrochemicals have appointed Plant Protection Ltd., as super distributors for Dowpon. This means that in addition to the extensive distributive organisation built up by Dow, which will continue to expand, farmers will also be able to purchase Dowpon through accredited Plant Protection agents all over the U.K.

It is expected by both companies that an even wider sales distribution of Dowpon will result from this arrangement. Demand for Dowpon has been growing rapidly as a result of its extensive use by leading farmers whose example is being copied by others. At the same time new applications involving the use of Dowpon and arising from years of trials by the leading agricultural research institutions of the country and by the experts of Dow Agrochemicals Ltd., are creating new and ever widening markets for the chemical. These factors have necessitated the agreement.

Dow International Introduce a new Coccidiostat

'Zoamix', a new product for control of coccidiosis in poultry, is being placed on the world market by Dow Chemical International Ltd. S.A.

As a superior material for prevention of this serious disease, Zoamix is expected to be rapidly accepted by the feed and poultry industries, according to C. E. Otis, Agricultural Products Sales Manager. Zoamix is the first product in its field permitted to be fed to birds straight through until slaughter. Other materials must be withdrawn prior to slaughter, causing an inventory problem.

Zoamix has enjoyed unusual success in several test markets this past year. The U. S. Food and Drug Administration has just issued a food additive regulation permitting the use of this product in chicken feed for the control of intestinal and cecal coccidiosis.

Zoamix is sold to feed manufacturers to be included in broiler feeds.

Most of these companies have tried Zoamix in their own laboratories as a part of the exhaustive test program of the product. Because of their experience with the product, the marketing program is aimed at supplying their needs as rapidly as possible.

Filters for the Chemical Industry

Plenty & Son Ltd. Engineers, have issued a leaflet to describe their new range of 'Duplex' filters which have been designed to meet the needs of the Oil, Chemical and Food Industries as well as for general Engineering and Marine use. Important features of the 'Duplex' filters, which are complimentary to the firm's Simplex range are the simple and robust construction incorporating smooth passages and very large basket area (up to 25 times pipeline area) for minimum pressure drop and infrequent attention; the baskets can be cleaned in turn without interruption to the continuous flow; they are treated against corrosion, and the range is from ½″ up to 30″.

Fison Airwork Ltd. Receive American Award

Fisons Pest Control Ltd., have announced that their associate company, Fison Airwork Ltd., has received the Bell Award for their pioneering work with helicopters as an agricultural tool. They are the first European company to receive this award.

The following is the wording of the citation:-

Bell Helicopter Corporation
Post Office Box 482 - Fort Worth, Texas

April 25th 1960

Fison Airwork Limited,
Bourn, Cambridge,
England.

Gentlemen:

It is my pleasure to announce that you are one of the first commercial helicopter operators to receive a Lawrence D. Bell Helicopter Pioneer Award. This award is given in grateful recognition of your contribution to the helicopter industry by the continuous operation of any make of helicopter for the past ten years or more.

The Lawrence D. Bell award is being made in his memory and in his steadfast belief in man. When Larry Bell received the world's first commercial helicopter certificate, he was convinced that other men of equally unshakeable faith in the machine would step forward and possess the necessary ingenuity to put his product to work. It is in this spirit that the courage and foresight of you and other pioneering commercial operators throughout the world are being honored.

An inscribed plaque bearing the name of your company is being prepared and as soon as arrangements are made, you will be advised of the proposed presentation date.

Everyone at Bell joins me in wishing you continued success in your helicopter operations during the next decade.

Sincerely,
Bell Helicopter Corporation
Harvey Gaylord (President)

New Product for the Control of Greenhouse Pests

Boots the Chemists claim to have developed an economical insecticide which gives effective control of most common insect pests under glass.

Based on Malathion, Lindane, and Chlorbenside, it is called "Boots Greenhouse Insecticide" and controls a wide variety of insect pests under glass including greenfly, blackfly, thrip, leaf hopper, white fly, leaf miner and red spider.

In a press button fumigator, it is sprayed into the air above the plants. One container, which costs 5s., will treat a house of 500 cubic feet ten times.

American Seed Dressing Experts' Visit to Britain

Mr. Wayne Gustafson, President of Ben Gustafson & Son Mfg. Co., and reputed to be America's top seed-dressing man, recently left London bound for Amsterdam on the first leg of his European tour. On leaving, Mr. Gustafson remarked upon the speed with which the Mist-O-Matic method of liquid seed dressing is being accepted in this country since its introduction in December last year and attributed this to the progressive attitude of British Merchants. He stated that, whilst the Mist-O-Matic method of seed treatment is now the most widley used in the U.S.A.—it is reported to be responsible for over 80% of all seed dressings done in the U.S.A.—it took longer for it to become established there than in this country.

British Schering have pioneered the use of this method for cereal dressings in Great Britain and are now actively engaged in the production of further specialized liquid dressings to be used for legumes, sugar beet, and overseas crops such as cotton, rice, maise and ground nuts.

R.A.S.E. Research Medal Awarded to Prof. Wain

In recognition of his work on plant growth regulating substances, selective weed control and systemic fungicides and insecticides, the Royal Agricultural Society of England Research Medal for 1960 has been awarded to Professor R. L. Wain, Ph.D., D.Sc., F.R.I.C.

This is the sixth award of the medal which is awarded annually for agricultural research work of outstanding merit undertaken in the United Kingdom. The medal carries with it a prize of 100 guineas.

Dr. Wain is Professor of Agricultural Chemistry in the University of London at Wye College. He is also Honorary Director to the agricultural Research Council's Unit of Plant Growth Substances and Systemic Fungicides which has been set up at Wye College.

Royal Show 1962.

Following a formal invitation from the Lord Mayor, Alderman Mrs. C. C. Scott, J. P., the Council of the Royal Agricultural Society unanimously decided to hold the 1962 Royal Show on the Town Moor Newcastle upon Tyne.

Fertilizer Society

At the Thirteenth Annual General Meeting of this Society held in Maidstone on Thursday, 19th May, 1960, Dr. H. L. Richardson was elected President and Dr. G. W. Cooke, Vice-President.

Dr. J. H. Hudson, Mr. A. H. Kaye and Mr. J. H. H. Peak were elected to fill vacancies on Council.

Liaison Officers

The Minister of Agriculture, Fisheries and Food has appointed Mr. Edward Maxwell Howard as his personal Liaison Officer for the counties of Derbyshire, Nottinghamshire and Lincolnshire (parts of Kesteven and Lindsey) in succession to Sir Cecil Armitage, C.B.E., D.L., J.P., who has resigned.

NEWS

Scientific Delegation Visits U.S.S.R.

On 16th May four leading scientists of Fisons Pest Control Ltd., namely Dr. G. S. Hartley, Dr. R. K. Pfeiffer, Dr. E. Parry Jones and Mr. A. L. Abel, left for an extensive tour of Russian research stations. Before they return in June they will have covered some 5,000 miles by air alone inside the Soviet Union. The tour is one of the most extensive of its kind and probably the first time that research scientists have been free to visit so many stations.

Following the arrival in Moscow the group will spend two days at the Research Institute of Fertilizers and Insectofungicides with a further two days set aside for visits to the Fertilizer and Soil Science Institute and Moscow University. From Moscow the group will travel to Leningrad to spend two days at the Plant Protection Research Institute and then journey on to Kiev where they will meet Prof. A. V. Kirsanov head of the Institute of Organic Chemistry and visit the Plant Protection Institute during their three day stay. Whilst in Kiev they will also look around the Institute of Safety Measures.

The remainder of the trip will include a two day visit to the Moldavian Research Station for Plant Protection, five days at the Plant Protection Institute and Middle Asian Machine Research Station in Tashkent and a final two days in Moscow to discuss the result of the trip. The party will no doubt bring back some interesting information and, it is hoped, some good pictures.

Fisons Pest Control technical delegation standing by the aircraft which took them to Moscow via Amsterdam. Reading from left to right—Dr. G. S. Hartley, Research Director; Dr. R. K. Pfeiffer, Head of Botanical Section; Dr. E. Parry Jones, Managing Director; Mr. A. L. Abel, Technical Director. *Photo—Fisons Pest Control*

P. B. I. Appoint Agricultural Aviation Consultant

Pan Britannica Industries Ltd., a member of the Tennant Group of Companies, announces the appointment of Air Commodore A. H. Wheeler, C.B.E., M.A. (Cantab.), F.R.Ae.S., Dutch D.F.C. (Vliegekries) as consultant to their Aviation Division. P.B.I. Aviation Division is at present, one of the largest operators of agricultural aircraft in the United Kingdom.

Air Commodore Wheeler's present duties include his role as Adviser to the Air Registration Board. He is Trustee and Governor of the Shuttleworth Agricultural College. In 1954 he served as Assessor on the Comet Inquiry.

Between 1952 and 1955 he was Head of the Experimental Establishment at Boscombe Down. He also commanded the Experimental Flying Department at the Royal Aircraft Establishment, the Airborne Forces Experimental Establishment and the Performance Testing Squadron at the Aeroplane and Armament Experimental Establishment of the Royal Air Force.

Agricultural aviation is still in its infancy and many basic aircraft development problems have still to be solved. Air Commodore Wheeler' long experience in aircraft development will undoubtedly be of great assistance in Agricultural Aviation on which subject he has written technical articles after making a study of the present state of its development.

Director of Tropical Products Institute Mr. E. S. Hiscocks to succeed Dr. R. A. E. Galley

Mr. E. S. Hiscocks, M.Sc.,F.R.I.C., at present the Director of the United Kingdom Scientific Mission in Washington, has been appointed to succeed Dr. R. A. E. Galley as the Director of the Tropical Products Institute, D.S.I.R. Dr. Galley is resigning to take up an appointment with the Shell group as research director and manager of the Woodstock Agricultural Research Centre at Sittingbourne, Kent.

Mr. Hiscocks, who is 56 has been in the United States since 1957 and is expected to take up his new post in the Autumn.

He was educated at Swansea Grammar School and University College, Swansea, graduated with Honours in 1924. The following year he gained his M.Sc. degree and in 1935 became a Fellow of the Royal Institute of Chemistry.

From 1926 to 1939 he served in the Department of the Government Chemist (now the Laboratory of the Government Chemist) and from 1939 to 1944 he was with the raw Materials Department of the Ministry of Supply. In 1944 he was appointed Secretary of the National Physical Laboratory.

Mr. Hiscocks, who is married and has one son, has made a special study of laboratory administration and in 1956 published a book under that title.

Dr. Robert Galley, who is 50, has been Director of the Tropical Products Institute since 1953. He is a leading authority on pesticides and has been a member of the World

Health Organisation's expert panel on pesticides since 1949.

One of the major problems which he has faced in recent years is the development of resistance by mosquito carriers of malaria to the insecticides commonly used, and he will continue active research in this field at the Woodstock Centre.

During his seven years as Director of the T. P. I., Dr Galley has made on-the-spot studies in many parts of the world, and he is particularly well known in East, Central and West Africa.

He is married, and has one son and two daughters.

New Varieties of Pyrethrum Developed

Two new varieties of pyrethrum with a high insecticidal content have been developed at the Kenya Government's agricultural research station at Molo, 8,250 feet up in the White Highlands.

Doctor Ulrich Kroll, the Senior Pyrethrum Officer in the Department of Agriculture, who is in charge of the Molo station, has been working on the development of new strains there for 15 years.

Of his two latest varieties C45 will produce flowers containing more than 1.7% pyrethrins between 7,000 and 8,500 feet above sea level, and M31 about 1.6% between 7,000 and 9,000 feet.

These strains, with many others suited to various conditions, are sold to local farmers in the form of seed or 'splits', a service which is increasingly popular.

The total output of seed at Molo has increased from 2,032 lbs. in 1958 to 5,234 lbs. during last year.

Dr. Ulrich Kroll

Kenya Plans Record Pyrethrum Crop

Kenya plans a record pyrethrum crop for the coming year July 1st, 1960 to June 30th, 1961

Annual licences are being issued to farmers to permit a total production of about 10,300 tons of the flower, which is cultivated for its amazing insecticidal properties.

Previous highest production was 7,409 tons produced in 1945 under British Government wartime guarantee.

The production planned shows a steep increase of about 63% on production for the current 12 month period, ending June 30th, 1960, which is expected to be 6,300 tons and all of which was sold several months ago. Production for the year ending June 30th, 1959, was 4,100 tons.

Production licences are issued to farmers by the Pyrethrum Board of Kenya, on which the farmers are represented, and which processes and markets the flowers. Production figures represent the amount of dried flowers thatfarmers sell to the board.

Preliminary marketing indications suggest that there is every possibility that the forthcoming year's production of pyrethrum will be fully absorbed. The value of these sales will be nearly £3½ millions, as compared with pyrethrum exports to the value of £2,196,286 in the calendar year 1959.

Over a period of three years the Pyrethrum Board of Kenya, having undertaken its own marketing in 1958, has achieved a position in which the production and sale of Kenya pyrethrum has more than doubled. Kenya is the world's largest source of pyrethrum.

An African plant pathologist inspects pyrethrum flowers at Molo

PUBLICATIONS RECEIVED

Hanna's Handbook of Agricultural Chemicals. Second Edition
By Lester W. Hanna, (obtainable from the author) Route 1, *Box* 210, *Forest Grove, Oregon, U.S.A. Price* $5.95

In just over 450 pages the descriptions of over 1,000 commercial chemicals and miscellaneous items are given. These include, fertilizers, fumigants, fungicides, weed killers, insecticides, livestock chemicals, rodenticides, official antidotes, emergency treatments, drugs, first aid, U.S.D.A. Pesticide Registrations, safety practices, chemical compatibility weather charts and others.

This handbook is very useful and is possibily the best of its kind on the market today (if their are any others). However, with a little more care and more selectivity with regard to some of the included material, it could have been an indispensable asset to anyone connected with the use of agricultural chemicals.

Whilst dealing with the chemicals used in agriculture (which have been listed, as far as possible, in alphabetical order under the American common names) the author gives briefly a few alternative names, the chemical names, properties and uses, safety precautions, and antidotes in the case of accidental poisoning. This aspect which comprises the main part of the book is excellent. Even though the descriptions of some of the chemicals appear to have been taken directly from the container labels there can be no objection for in the majority of cases a label will summarise in the most concise terms the most important findings of the manufacturer's studies.

Also, if the author had tried to re-write everything and summarise all the available information concerning each product, the book would have been hoplessly out of date before the manuscript was published. No! when considering the aim of the book and realising the field to be covered the only fair objection we can make is the miscellaneous items concerning frost detectors, frost guards, blasting cap accidents, lorry headlighting schemes, etc. which have been flung in at the end of the book. Some of these items read like publicity blurbs by over-enthusiastic P.R.O.'s and to quote an old northern saying are "neither nowt nor som'at."

When the author writes the third edition and we are sure he will, we hope that he will confine himself solely to agricultural chemicals, by so doing he will improve his publication and provide a great service for manufacturers and users of agricultural chemicals.

Recognition of Diseases and Pests of Farm Crops.
By Ernest Gram, Prosper Bovein and Chr. Stapel, published by the Danish Agricultural Information and Advisory Aids Service. Distributors in Great Britain W. Heffer & Son, Cambridge. Price 35/-.

"Plant diseases and pests will always be, to a greater or lesser extent, one of the farmers worst head aches, bringing as they do material loss in their wake. Many of these attacks can be waided off provided the farmer is in a position to recognise the enemy within his gates and to supply the correct weapon for its destruction."

With the above in mind the authors originally produced this book, which consists of 112 colour plates showing over 800 examples, in order that the Danish farmer could become aquainted with most of the pests and diseases that occur in his country.

By and large, however, the same diseases and pests appear in crops all over the north-western part of Europe and the Danish Agricultural Information and Advisory Aids Office, therefore, was of the opinion that all countries within this area might benefit if this work were made available to them in their own languages. To this end a condensed text has been translated into English, Swedish, German, Dutch and French.

The text deals solely with the subjects depicted in the colour plates, i.e. the recognition of the various pests and diseases, and all references to biological conditions, control, etc., has been omitted. This is intentional since control is subject to frequent change and in any event varies from country to country. The colour plates, however, are expected to remain topical for a long time.

In addition to an English index there is also an index of scientific names which is very useful and it is a policy which could well be used for other publications.

Diseases and Pests on Horticultural Planting Material
'A Guide to their Recognition'
Published by H.M.S.O., London, for the Ministry of Agriculture Fisheries and Food. Price 7/6d.

This booklet first published in 1953 and revised in 1958 retains its original value and purpose. Its aim is to provide a guide to the recognition of the diseases in pests as they occur in the dormant or semi-dormant planting material which is subject to inspection just prior to export from, or entry into, the country

It lists, alphabetically and, as far as possible, under the common English name, some 130 horticultural plants which are commonly to be found moving in international traffic. Under each plant the diseases and pests that might be found on planting materials are listed and their chief diagnostic features briefly described. As a further aid some 83 photographs illustrating some of the diseases, are also included.

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Of prime importance in this, the most recent, issue of *Agricultural Avaition* is the list of herbicides, fungicides and insecticides which are suitable for aerial application. The active ingredient its percentage, and the formulation of nearly 1,000 trade named products, marketed by 50 chemical companies in the E.A.A.C. member countries are indicated.

Other articles of interest are (1) "Aerial Control of Continental Voles (*Microstus arvalis*, Pallas) in Germany", by Dr. B. Lange, Plant Protection Service, W. Germany, in which the author shows that aerial spraying with toxaphone, endrin/aldrin and endrin / toxaphene, can provide a successful, economic and safe method of controlling the Continental vole (See *Pest Technology*, **2** (3) 46-48).

(2) Control of Peamoth (*Enarmonia nigricana* Fab.) in the Netherlands, by Dr. C. J. H. Franssen and Miss M. C. Kerssen, Institute of Phytopathological Research, Wangeningen, which discusses methods for the determination of the correct timing of application and shows that Parathion is more successful than D.D.T. for aerial application against the Peamoth.